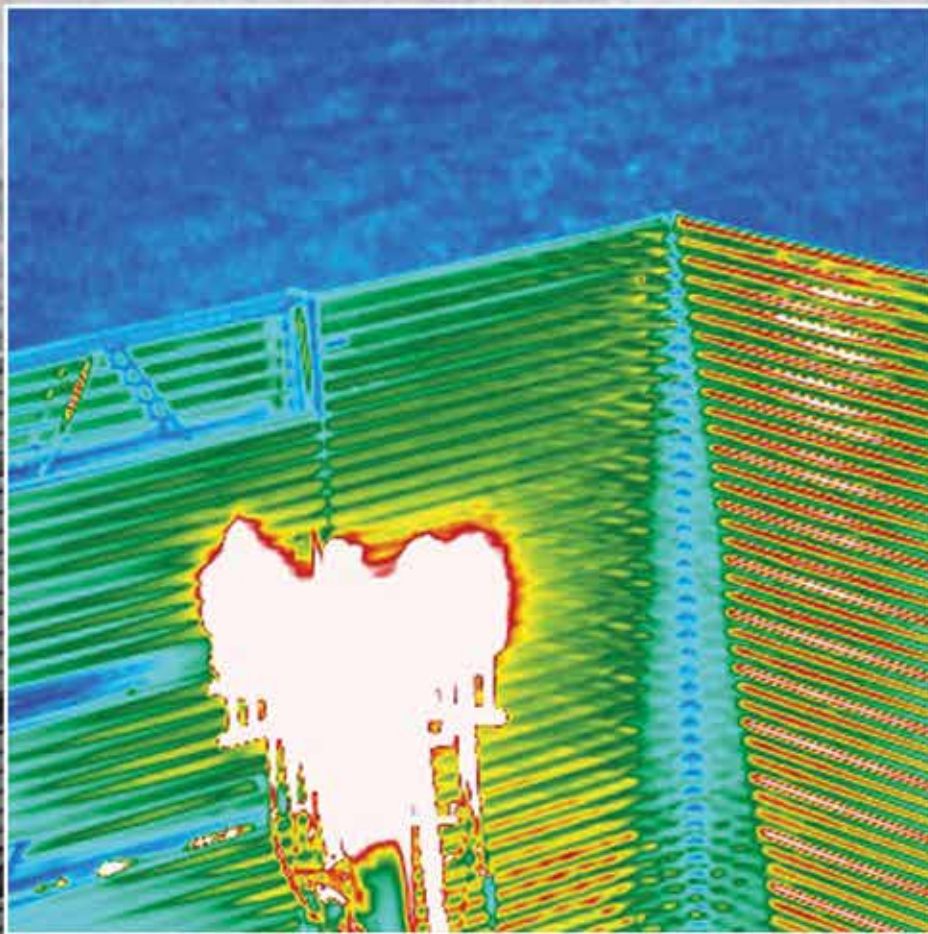
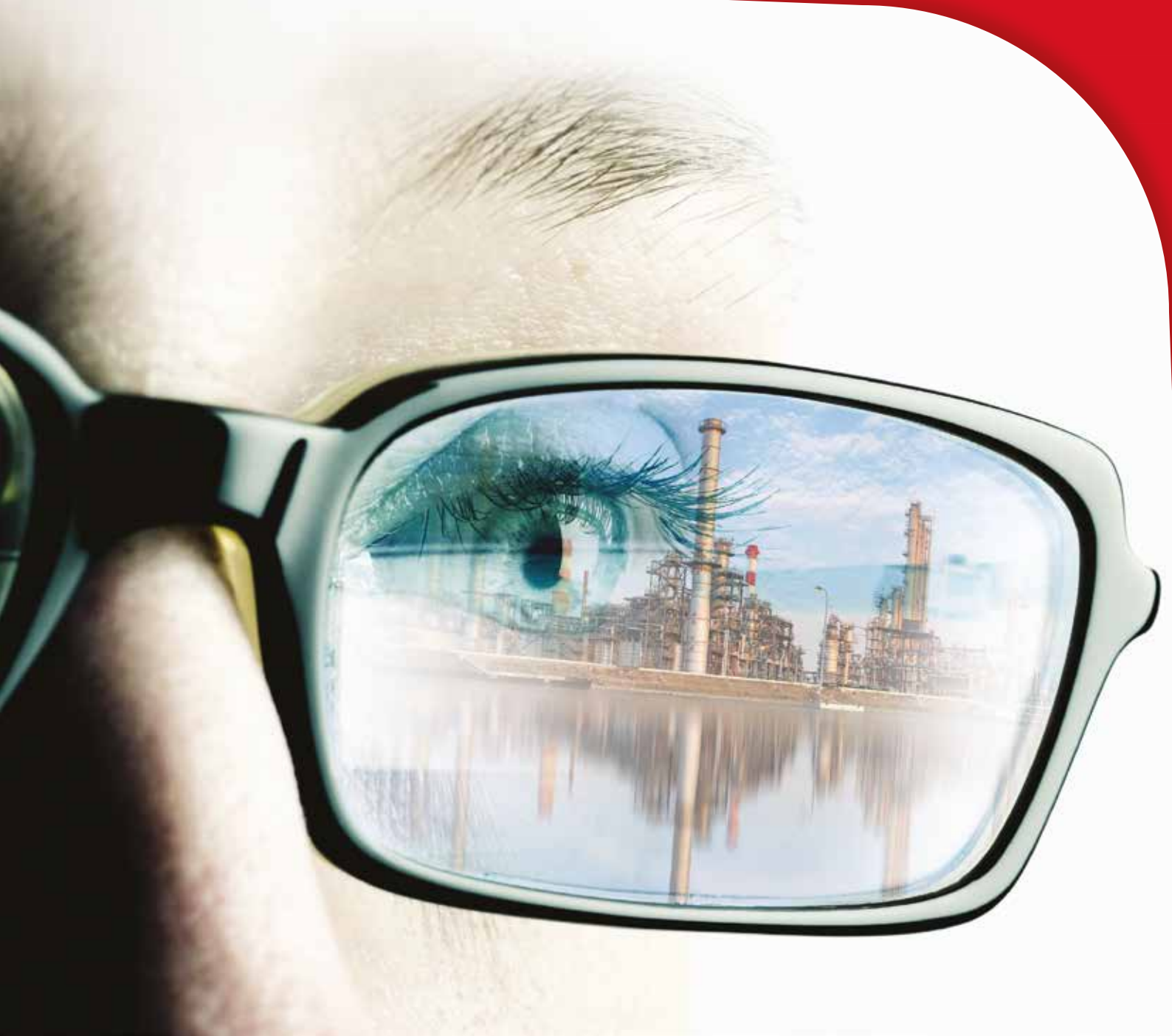


HYDROCARBON ENGINEERING

January 2018



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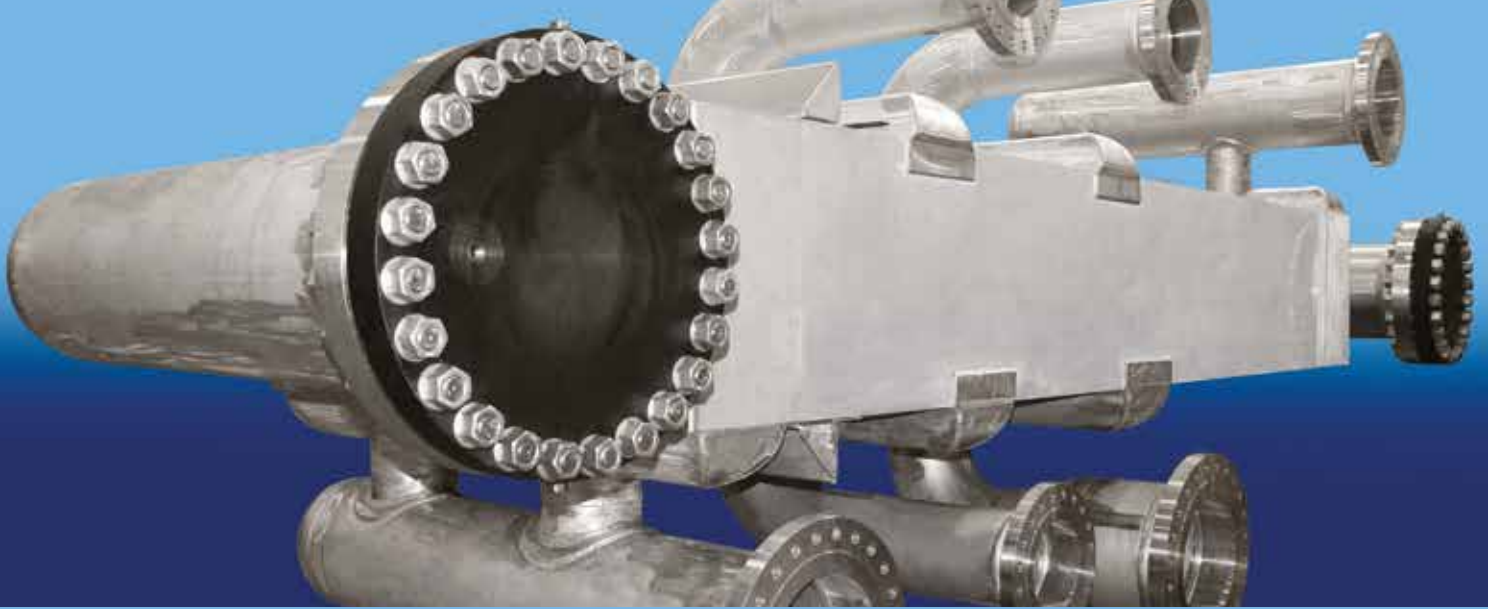
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HYDROCARBON ENGINEERING



CALLUM O'REILLY EDITOR

As we head into the new year, OPEC has done its best to create a level of stability for the foreseeable future. Following the latest meeting of its members on 30 November 2017, the organisation announced that its production cuts would be extended until the end of 2018 (with an agreement to review in June). Libya and Nigeria have also agreed to cap their production. Although widely expected, the news would have been warmly welcomed by much of the industry. Westwood Global Energy Group warned that without the extension cuts, the market would have reverted to excess supply and potentially lower oil prices this year.¹ However, while the decision to extend the cuts should support oil prices in 2018 – both Brent Crude and WTI opened the year at above US\$60/bbl for the first time since January 2014 – Westwood argues that a further extension of the cuts may be necessary beyond the end of this year: "If the OPEC cuts come to an end in December [2018], Westwood's data suggests that the market will be oversupplied until next decade."

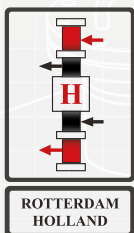
The problem for OPEC, as Deloitte's John England explains in his take on the '2018 outlook on oil and gas', is that it appears to be "running out of cards."² Supply increases (from the US in particular) and slow demand growth have combined to hamper the pace at which the market is rebalancing. England writes: "At some point, the market still needs a real demand boost to get prices moving upward in a meaningful way. Unfortunately, right now, it's not clear if that card is still in the deck."

Looking further ahead, OPEC has a difficult juggling act on its hands. Its production cuts are certainly essential to the current recovery, but higher oil prices bring the danger of increased supply from the US. It is becoming increasingly apparent that the timing and strategy of its eventual exit from these cuts will be just as important as its decision to start the policy in November 2016.

Returning to John England's outlook for oil and gas in the year ahead, it is interesting to note that a whole section of his report has been devoted to the digital revolution. England explains: "In a world where the assumption that energy demand would rise forever seems to be wavering, one path to success is to be a low-cost provider, whether of energy commodities or of the equipment and services needed to produce these commodities and get them to market." While digital technologies have the potential to be a game changer for those willing to innovate and invest, England warns that the pace of change has the potential to create both winners and losers: "The digital cavalry is coming, but it likely won't rescue everyone – possibly only those who are brave enough to embrace it."

This issue of *Hydrocarbon Engineering* includes a number of articles explaining how digital advancements are helping to improve plant design, enhance operations, increase productivity and revamp maintenance strategies (starting on p. 22).

1. COOK, M. and ROBERTSON, S., 'Westwood Insight: OPEC - Holding Firm, For Now', Westwood Global Energy Group, (4 December 2017).
2. ENGLAND, J., '2018 outlook on oil and gas', Deloitte.



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WORLD NEWS

Germany | Zenith acquires terminalling assets

Zenith Energy L.P. has signed an agreement to acquire a liquids storage terminal facility in Hamburg, from Royal Dutch Shell plc. The transaction is expected to close in 1H18.

The facility, located on 55 ha., serves as a refined product import and blending terminal in north Germany with an expected storage capacity of over 480 000 m³ (3 million bbls) for gasoline, diesel and jet fuel; inbound and outbound ocean vessel, barge, rail and truck; and pipeline

connectivity in the Port of Hamburg.

After transferring ownership to Zenith, Shell will remain a significant customer of the terminal. The acquisition of the Hamburg assets represents Zenith's third terminal in Europe following its acquisition of terminalling assets in Amsterdam from BP in April 2016 and its acquisition of the Bantry Bay terminal in Ireland from Phillips 66 in February 2015.

Terms of the transaction were not disclosed.

Australia | LNG exports to increase

The value of Australia's LNG exports is forecast to increase from AUS\$22 billion in 2016 – 2017 to AUS\$36 billion in 2018 – 2019, according to the latest quarterly report from the Department of Industry, Innovation and Science.

The increase is driven by higher export volumes and higher prices.

The completion of the final three Australian LNG projects under construction (Wheatstone, Ichthys and Prelude) will underpin strong growth in export volumes and bring export capacity to 88 million tpy.

LNG contract prices are forecast to increase in line with oil prices. High LNG spot prices in Asia are also likely to be attractive to Australian exporters in the short-term, but are expected to decline from their present level.

The report also suggests that LNG is forecast to overtake metallurgical coal as Australia's second largest resource and energy export in 2018 – 2019.

Meanwhile, the country's crude oil and condensate exports are forecast to increase from AUS\$5.5 billion in 2016 – 2017 to AUS\$6 billion in 2017 – 2018, driven by the higher oil prices. Further increases are expected in 2018 – 2019, as higher condensate production supports forecast export earnings of AUS\$7 billion.

Belgium | Jacobs to undertake engineering study for chemical plant

Jacobs Engineering Group Inc. has been awarded a contract to complete a front-end engineering and design (FEED) study for a propane dehydrogenation (PDH) plant located at the existing Borealis production site in Kallo.

The contract award follows the successful completion of the feasibility study for the plant. Upon completion, the new PDH plant will have a targeted production capacity of 740 000 tpy – this would make it one of the largest facilities in the world.

As part of the FEED study, Jacobs is preparing the basic design

package for the inside and outside battery limit areas of the new PDH plant. The FEED phase is due to be completed by mid-2018.

"A new and innovative PDH plant of this scale would be a significant investment in the chemical industry in Europe and a response to market demand for polypropylene and propylene," said Jacobs Petroleum and Chemicals President, Vinayak Pai. "We look forward to continuing our relationship with Borealis through the next development phase of this world-scale petrochemical plant."

USA | Enterprise to increase capacity at Texas facility

Enterprise Products Partners L.P. has announced that it intends to add 300 million ft³/d of incremental capacity at its cryogenic natural gas processing facility under construction near Orla, Texas. The addition of a third processing train would increase inlet volume capacity to

900 ft³/d and allow Enterprise to expand its natural gas liquid (NGL) extraction capabilities by an incremental 40 000 bpd to 120 000 bpd.

The third processing train is expected to begin service in 2Q19, complementing trains one and two, which are scheduled for

completion in 2Q18 and 3Q18, respectively.

Once the Orla expansion projects are complete, Enterprise will have a total natural gas processing capacity of more than 1.2 billion ft³/d and the ability to extract more than 200 000 bpd of NGLs in the Permian Basin.



WORLD NEWS

IN BRIEF

DENMARK

Shell has announced that the agreement it made with Dansk Olieelskab AS in September 2016 to sell A/S Dansk Shell will not go through. Consequently, A/S Dansk Shell, which is made up of the Fredericia refinery along with local trading and supply activities, will continue to be owned by Shell and operate as normal.

WORLDWIDE

SNC-Lavalin has reached a framework agreement with Shell, in which it will deliver pre-feasibility and feasibility studies for modular options on a range of Shell's projects. Under the terms of the agreement, SNC-Lavalin's work in this area will be undertaken in Singapore, Dubai and Houston, Texas, US.

USA

Koch-Glitsch and EFT Analytics have announced a partnership to provide service process engineering and data analytics solutions to enhance operations for refineries and petrochemical plants. The companies hope that their work can be used to understand critical operating parameters in order to improve plant procedures and reduce downtime.

ABU DHABI

The Abu Dhabi National Oil Co. (ADNOC) has agreed to sell granulated sulfur to the OCP Group of Morocco (OCP) until 2025. The two companies also agreed to consider an increase in the stipulated annual volumes in the future.

USA | McDermott and CB&I to combine

McDermott International Inc. and CB&I have agreed to combine in an all-stock transaction to create a premier fully vertically integrated onshore-offshore company, with a broad engineering, procurement, construction and installation (EPCI) service offering and leading technology portfolio.

Upon completion of the transaction, McDermott shareholders will own approximately 53% of the combined company on a fully diluted basis and CB&I shareholders will own approximately 47%.

The estimated enterprise value of the transaction is approximately US\$6 billion, based on the closing share price of McDermott on 15 December 2017.

David Dickson, President and CEO of McDermott, said: "This transaction combines two highly complementary businesses to create a leading onshore-offshore EPCI company driven by technology and innovation, with the scale and diversification to better capitalise on global growth opportunities."

Canada | Inter Pipeline to build petrochemical complex

Inter Pipeline Ltd's board of directors has authorised the construction of a world-scale integrated propane dehydrogenation (PDH) and polypropylene (PP) plant. The facilities, collectively referred to as the Heartland Petrochemical Complex, are estimated to cost CAN\$3.5 billion in aggregate and will be located in Strathcona County, Alberta, near Inter Pipeline's Redwater olefinic fractionator.

The Heartland Petrochemical Complex will be designed to convert locally sourced, low-cost propane into 525 000 tpy of PP, a high value, easy to transport plastic used in the manufacturing of a wide range of finished products.

Construction of the complex will continue in early 2018 with completion scheduled for late 2021.

USA | Grace to acquire Albermale's polyolefin catalysts business

W. R. Grace & Co. has signed an agreement to acquire the polyolefin catalysts business of Albemarle Corp. for US\$416 million.

The transaction is expected to close in 1Q18, subject to regulatory approvals and other customary closing conditions.

The acquisition includes a series of Ziegler-Natta catalysts for polyethylene production.

Approximately 175 employees will join Grace's global team.

Grace believes that the two manufacturing operations in Baton Rouge, Louisiana, and Yeosu, South Korea, will add important flexibility to the company's global catalysts manufacturing network, enhancing its ability to meet customer needs across multiple regions.



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WORLD NEWS

IN BRIEF

USA

INEOS Oligomers has made the final investment decision (FID) to build a new world scale, low viscosity polyalphaolefin (PAO) unit on the INEOS site at Chocolate Bayou, Texas. The PAO unit will have a capacity of 120 000 tpy and will become the world's largest single PAO train. The plant is scheduled to start-up in 3Q19. The new unit will obtain its feedstock from the adjacent linear alpha olefin (LAO) plant, which is currently under construction at the same site.

CHINA

BASF and Sinopec will expand the neopentyl glycol (NPG) production capacity at its Verbund site in Nanjing. The plant was established in 2015 with an annual capacity of 40 000 t. Following the expansion, the capacity will double to 80 000 tpy. The expanded capacity will come on stream in 2020.

KAZAKHSTAN

CB&I has received full notice to proceed by Kazakhstan Petrochemical Industries Inc. (KPI) for the project management services for a propane dehydrogenation (PDH) unit and a polypropylene (PP) plant in the western Atyrau region of Kazakhstan. The PDH unit uses CB&I's CATOFIN® PDH technology, and the PP plant uses the company's Novolen® advanced gas-phase polypropylene technology.

USA

Jacobs Engineering Group Inc. has completed its acquisition of CH2M via a cash and stock transaction. The combination, which received broad affirmative support from CH2M shareholders, is expected to drive the company's profitable growth strategy further.

USA | Chevron Phillips Chemical Co. completes ethane cracker

Chevron Phillips Chemical Co. has announced the successful mechanical completion of its ethane cracker at Cedar Bayou in Baytown, Texas.

In order to guarantee a smooth start-up and the desired production, the cracker is currently being subjected to numerous commissioning tests, system checks and mandatory certifications. The company anticipates that the unit – for which 5000 workers were required – will generate a minimum of 1.5 million tpy.

When the cracker begins production, it will create product for Chevron Phillips Chemical's ethylene

business as well as feedstock for its ethylene derivatives businesses. The unit joins the company's two new polyethylene (PE) units at Old Ocean, Texas, and forms another part of the company's drive to meet the increasing worldwide demand for PE. The units create various polyethylene resins, such as metallocene LLDPE film and bi-modal film.

Supplementing the completion of the cracker and PE units is the company's purchase of approximately 3000 new rail cars, along with the construction of a storage-in-transition facility; the latter will ship PE by rail to national consumers and ports for global export.

China | Exmar takes delivery of FSRU

Exmar has taken delivery of the world's first barge-based floating storage and regasification unit (FSRU).

Delivered from the Wison shipyard in the Chinese port of Nantong, the unit's specifications include a maximum regasification capacity of 600 million ft³/d and a storage capacity of 26 000 m³ of LNG. The delivery is being hailed by Exmar as a

major breakthrough, as the FSRU has become the first of a new generation of barge-based floating regasification assets. The company anticipates the unit becoming a pivotal part of its global portfolio of medium-sized LNG import projects.

Long-term employment for the FSRU has been established and hiring will begin from mid-2018.

Argentina | Trafigura buys downstream assets

Trafigura Group Pte Ltd has signed a sale and purchase agreement (SPA) for the majority of Pampa Energia S.A.'s downstream assets, including over 250 service stations, the Ricardo Elicabe (BBR) refinery and a lubricants manufacturing facility in Avellaneda, as well as a fuel storage terminal in Caleta Paula, in the province of

Santa Cruz, which serves the southern region of Argentina.

This marks a further step in Trafigura's Argentina investment programme, which already includes a fluvial fleet and the Campana Terminal, which supplies the Argentinian, Paraguayan and Bolivian markets with petroleum products via the Parana River.

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WORLD NEWS

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www.me-tech.biz

20 - 22 February 2018

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www.ipweek.co.uk

25 - 28 February 2018

Laurance Reid Gas Conditioning Conference

Norman, Oklahoma, USA

pacs.ou.edu/lrgcc/

11 - 13 March 2018

AFPM Annual Meeting

New Orleans, Louisiana, USA

www.afpm.org/conferences

13 - 15 March 2018

Asia Turbomachinery & Pump Symposium

Singapore

atps.tamu.edu

20 - 22 March 2018

StocExpo Europe

Rotterdam, the Netherlands

www.stocexpo.com

15 - 18 April 2018

GPA Midstream Convention

Austin, Texas, USA

www.gpamidstreamconvention.org

15 - 19 April 2018

Corrosion 2018

Phoenix, Arizona, USA

www.nacecorrosion.org

29 April - 3 May 2018

SOGAT

Abu Dhabi, UAE

www.sogat.org

11 - 15 June 2018

ACHEMA 2018

Frankfurt, Germany

www.achema.de

25 - 29 June 2018

World Gas Conference

Washington DC, USA

www.wgc2018.com

USA | DOE announces modernisation plans

The US Department of Energy (DOE) has announced its intent to modernise its organisational structure to advance its policy goals, consistent with statutory requirements.

Under the DOE Organization Act, the Secretary of Energy has the authority to organise the department in order to meet the needs of the current time and support and advance the policy priorities of the new administration. Those priorities are: achieving US energy dominance; protecting energy and national security; advancing innovation; and improving outcomes in environmental management.

Under the new plan, the current office of Under Secretary for Science and Energy (established in 2013 during Secretary Moniz's tenure) will be separated into two Under Secretary positions so that there will be three Under Secretaries: the Under

Secretary of Energy; the Under Secretary for Science; and the Under Secretary for Nuclear Security and NNSA Administrator, as is consistent with DOE's statutory mandate.

The Under Secretary of Energy will focus on energy policy, applied energy technologies, energy security and reliability, and certain DOE-wide management functions, while the Under Secretary for Science will focus on supporting innovation, basic scientific research, and environmental cleanup.

In addition, elements of the current Under Secretary for Management and Performance's portfolio will fall under the responsibility of the Deputy Secretary of Energy.

Another change to the agency's organisation will include replacing the Office of Energy Policy and Systems Analysis with an Office of Policy.

Worldwide | Study suggests cyber security adoption is low

Honeywell has released a new study that shows how industrial companies are not moving quickly to adopt cyber security measures to protect their data and operations, even as attacks have increased globally.

The survey, entitled 'Putting Industrial Cyber Security at the Top of the CEO Agenda', was conducted by LNS Research and sponsored by Honeywell. It polled 130 strategic decision makers from industrial companies about their approach to the Industrial Internet of Things (IIoT), and their use of industrial cyber security technologies and practices.

More than half of respondents reported working in an industrial facility that has already had a cyber security breach. Of the responding companies, 45% said that they still do

not have an accountable enterprise leader for cyber security, and only 37% are monitoring for suspicious behaviour. Although many companies are conducting regular risk assessments, 20% are not doing them at all.

The study suggests three immediate actions for any industrial organisation to capture the value of the new technologies. These include making industrial cyber security part of digital transformation strategies; driving best practice adoption across people, processes and technology, from access controls to risk monitoring, and tap external cyber expertise to fill gaps; and focusing on empowering leaders and building an organisational structure that breaks down the silos between IT and OT.

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A satellite map of the Middle East and North Africa region, showing the Red Sea, Persian Gulf, and surrounding landmasses. The map is used as a background for the title and introductory text.

Dr Nancy Yamaguchi, Contributing Editor, provides a regional focus on the Middle East and North Africa.

TRACKING MENA TRENDS

A satellite map of the Middle East and North Africa (MENA) region. The map shows the Arabian Peninsula, the Red Sea, the Persian Gulf, and the surrounding landmasses. The colors are naturalistic, showing the brown and tan of the desert and the dark blue of the water.

The Middle East and North Africa (MENA) is famous for its oil and gas resources, and is home to key OPEC countries that are collectively responsible for the bulk of OPEC crude production (Algeria, Libya, Iran, Iraq, Kuwait, Qatar, Saudi Arabia, and the UAE). Although these countries are well-known, MENA also includes countries that have to import most, or all, of the crude oil they require, or refined product if they do not have refineries. In North Africa, Morocco produces almost no oil, and Tunisian output is modest and declining. In the Middle East, Jordan, Lebanon and Israel produce little or no petroleum. Syrian production has been crippled by chronic war and Yemen's production also has dwindled because of internal unrest.

Therefore, although the MENA region is perhaps best known for its OPEC members, the countries are divided into 'haves' and 'have-nots' with respect to oil wealth. Seven of the eight OPEC members in MENA are cooperating in an agreement to reduce oil production, thus

decreasing global oversupply. Yet, the other MENA countries are oil importers and benefit from inexpensive oil. This regional focus will cover all of the countries and present a regional picture of trends.

North Africa

The following sections compare crude oil production to total oil demand for each of the North African countries. This type of comparison provides a rough guide to whether each country is a net exporter or a net importer of oil, and establishes whether net exports/imports have been growing or shrinking.

The main source of data for the infographics is the Organization of Arab Petroleum Exporting Countries (OAPEC), which is based in Kuwait. The data series covers the 2009 – 2015 period. For OPEC members, the OPEC Secretariat provides more current information on crude production, which, at the time of this writing, extends all the way through the first three quarters of 2017.

Table 1 presents OPAEC's series on North African crude production in 2009 – 2015. Regional production fell at an average rate of 6.6% per year, largely because of turmoil in Libya, where production fell drastically. In 2009, production in the region averaged 3.32 million bpd but this fell to 2.3 million bpd by 2015.

Table 2 presents OPAEC's view of North African oil demand in 2009 – 2015. Regional demand grew at an average rate of 1.8% per year, though continued violence in Libya caused its demand to contract at 6.4% per year, on average. North African demand was 1.64 million bpd in 2009, which grew to 1.83 million bpd in 2015.

Algeria

After making its first commercial oil discovery in 1956 and commencing production in 1958, Algeria became an OPEC member in 1969. The country has emerged as Africa's top producer of natural gas. Its natural gas output has stagnated, however, and oil production has declined. In 2009, crude output was 1.22 million bpd, declining to 1.16 million bpd in 2015. OPEC data reports that Algerian production has averaged 1.1 million bpd during the first

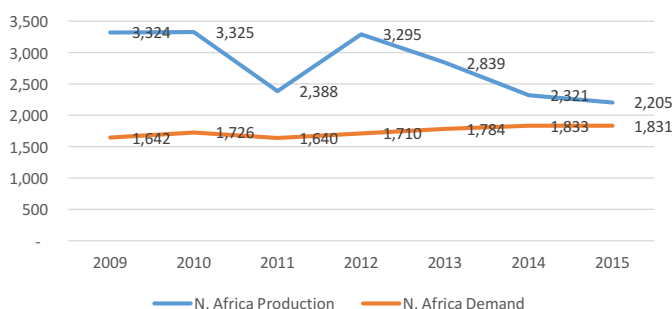


Figure 1. North Africa: production varies and net exports shrinking.

Table 1. North African oil production ('000 bpd). Source: OPAEC

	2009	2010	2011	2012	2013	2014	2015	AAGR 2009 – 2015 (%)
Algeria	1221	1190	1162	1203	1203	1193	1157	-0.9
Egypt	546	561	566	570	580	593	596	1.5
Libya	1474	1495	590	1454	993	480	402	-19.5
Morocco	1	1	1	1	1	1	1	0
Tunisia	82	79	70	67	63	54	50	-8
Total	3324	3325	2388	3295	2839	2321	2205	-6.6

Table 2. North Africa products consumption ('000 bpd). Source: OPAEC

	2009	2010	2011	2012	2013	2014	2015	AAGR 2009 – 2015 (%)
Algeria	308.6	310.5	329.1	351.9	386.7	376.5	397.7	4.3
Egypt	729.6	719.2	710.8	737.8	790.1	811.4	815	1.9
Libya	314.1	340.4	230.5	240.2	224.1	246.5	211.3	-6.4
Morocco	202.5	268.4	281.7	290.9	293	308.5	308.5	7.3
Tunisia	87.1	87.7	87.4	89.5	89.7	94.5	98.2	2
Total	1641.9	1726.1	1639.5	1710.3	1783.6	1833.1	1830.7	1.8

three quarters of 2017. This is slightly above Algeria's allotment under the OPEC production cut agreement, which gives Algeria a target of 1.4 million bpd.

Algerian oil demand has trended up, growing from 309 000 bpd in 2009 to 398 000 bpd in 2015. In net terms, therefore, Algeria's exportable surplus shrank by approximately 153 000 bpd.

Egypt

Egypt is a significant producer of oil and natural gas, though its large population and demand prevent it from becoming a significant exporter. The energy industry has suffered in the aftermath of the Arab Spring uprisings and 2011 revolution as revenue from tourism and foreign investment both dropped sharply. The national oil company has been saddled with debt, and its inability to pay creditors and foreign partners is creating delays and cancellations in energy projects. The government has been trying to reduce subsidies on energy prices, but this is proving to be difficult politically.

Egyptian crude production increased from 546 000 bpd in 2009 to 596 000 bpd in 2015. Demand was 730 000 bpd in 2009, declined to 711 000 bpd in 2011 (during the revolution year), and grew to 815 000 bpd in 2015.

Libya

Libya has the largest oil reserve base in Africa, as well as the fifth-largest natural gas reserve. However, the country's energy industry has been hobbled by chronic violence. Oil production has been as high as 18 million bpd, but it crashed below 500 000 bpd in 2014 and it averaged 402 000 bpd in 2015. There were multiple attacks on oil-related infrastructure, from the oilfields, to the pipelines, to the loading terminals and ports. An uneasy peace now comes and goes, and

Libyan crude production recovered to an average of approximately 770 000 bpd during the first three quarters of 2017. The national oil company (NOC) plans to raise output to 1 million bpd during 4Q17.

Demand has also been constrained by civil war. OPAEC reports that Libya's oil demand was 340 000 bpd in 2010, and that this fell to 211 000 bpd in 2015.

Morocco

Morocco produces a very small volume of crude oil, variously reported at 100 – 500 bpd. According to OPAEC, Moroccan demand has grown rapidly, from 202 500 bpd in 2009 to 309 000 bpd in 2015.

Tunisia

Tunisia is a key crude producer, but production is sagging. In 2009, crude output was 82 000 bpd. This slid to approximately 50 000 bpd in 2015. Investment in the upstream sector has

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IRAQ OIL CO. SIGNS MOU WITH JACOBS

The Iraq Oil Co. and Jacobs have signed a Memorandum of Understanding (MoU) with a view to exploring the mutual benefits of cooperation and joint investment in upstream, downstream, refining and other sectors. The companies hope that the MoU will facilitate socio-economic development in the Basra region of Iraq, where a high proportion of the country's oil production occurs.

GOMG HOLDINGS COMPLETES SALE OF STAKE IN REFINERY

The owners of GOMG Holdings Ltd, Mr Sargeant and Mr Abu Naba'a, have announced the final sale of their minority interest in the oil refinery in Ballsh, Albania, to their local Albanian partner, Ionian Refining and Trading Co. (IRTC), finalising a process that started before June 2017.

EIA: US GASOLINE PRICES UP IN 2017

Figures released by the US Energy Information Administration (EIA) show that US regular retail gasoline prices averaged US\$2.41/gal. in 2017, US\$27/gal. higher than in 2016, but US\$2/gal. less than in 2015. Higher crude oil prices in 2017 contributed to higher gasoline prices.

ESPOO ADOPTS RENEWABLE DIESEL

The Public Works Department in the Finnish city of Espoo has decided to use Neste MY Renewable Diesel in all of its diesel-powered machines. The product is produced from waste and residues. The transition to renewable diesel is part of a target to make the city completely carbon neutral by 2030.

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been hindered by low global oil prices and government lease terms that failed to attract investors.

Demand grew from 87 000 bpd in 2009 to 98 000 bpd in 2015.

North African oil production vs demand

While the five North African countries are a net oil exporting region, production has varied tremendously, demand has crept up steadily, and the exportable surplus has dwindled. In 2009, crude production was 3.32 million bpd vs oil demand of 1.64 million bpd, yielding a surplus of approximately 1.68 million bpd. In

2015, crude production fell to 2.21 million bpd, while demand grew to 1.83 million bpd. The gap between crude supply and oil demand had shrunk to 374 000 bpd.

The greatest source of uncertainty has been Libya. The country's output has see-sawed as warring factions have taken over or attacked oil infrastructure.

Libya is not a participant in the OPEC production cut agreement. Instead, it is trying to restore output to prior levels. Crude production has hit highs of nearly 1.5 million bpd, and has plummeted to lows of 300 000 bpd. OPEC reports that production averaged 766 000 bpd during the first three quarters of 2017, and the country plans to raise production to 1 million bpd in 4Q17.

Table 3. Middle Eastern oil production ('000 bpd). Sources: OAEPC for Arab Middle East; BP for Iran; IEA for Israel

	2009	2010	2011	2012	2013	2014	2015	AAGR 2009 – 2015 (%)
Bahrain	182	182	190	173	197	202	202	1.8
Iran	4292	4417	4465	3819	3615	3725	3897	-1.6
Iraq	2346	2359	2359	2942	2980	3100	3482	6.8
Israel	0.1	0.1	0.4	0.2	1.3	1.6	1.5	52.7
Jordan	0.03	0.02	0.02	0.02	0.02	0.02	0.01	-16.7
Kuwait	2262	2312	2659	2870	2708	2692	2883	4.1
Lebanon	-	-	-	-	-	-	-	-
Oman	713	865	781	814	844	856	885	3.7
Qatar	733	733	734	736	724	709	649	-2
Saudi Arabia	8180	8166	9311	9763	9637	9713	10 193	3.7
Syria	375	387	330	170	31	10	10	-45.6
UAE	2242	2324	2564	2653	2797	2794	2989	4.9
Yemen	284	275	190	180	159	140	24	33.8
Total	21 609	22 019	23 583	24 120	23 693	23 953	25 215	2.6

Table 4. Middle East oil product consumption ('000 bpd). Sources: OAEPC for Arab Middle East; BP for Iran and Israel

	2009	2010	2011	2012	2013	2014	2015	AAGR 2009 – 2015 (%)
Bahrain	24.8	26	24.2	26.4	27	27.6	28.7	2.5
Iran	4292	4417	4465	3819	3615	3725	3897	-1.6
Iraq	400.9	469.1	521.5	569.4	584.3	485.6	464.2	2.5
Israel	227	200.7	210.1	222.8	218.9	224.8	235.9	0.6
Jordan	93.7	102.5	126.4	140.3	135.8	152.5	131.3	5.8
Kuwait	259	286	248.4	229.6	267	240.7	275.6	1
Lebanon	128.9	120.4	124.4	126.6	125	128.1	132.1	0.4
Oman	108.6	149.6	163.2	186.1	172	190.2	197.6	10.5
Qatar	86	88	98	108	113.4	130.2	142	8.7
Saudi Arabia	1405.2	1491.1	1588.7	1690.5	1779.6	1917	2053	6.5
Syria	427.7	308.5	313.5	250.1	183.9	178.2	164.6	-14.7
UAE	292.2	309.2	307.1	323.1	404.7	385.6	417	6.1
Yemen	131.2	161.6	135.4	129.9	134	118.2	116.6	-1.9
Total	7877.2	8149.4	8326	7821.7	7760.2	7904	8255.8	0.8

Middle East

The following sections are overviews of Middle Eastern countries, comparing their crude oil production with oil demand to sort them by net importer vs exporter status, and examine how net exports/imports have changed in recent years. OAEPC is the key data source for the charts. The data exclude two non-Arab Middle Eastern countries: Iran and Israel. For these countries, data from BP and the International Energy Agency (IEA) are used.

Table 3 provides details on Middle Eastern oil production in 2009 – 2015. On a regional basis, crude production expanded at a rate of approximately 2.6% per year. In 2009, production was 21.61 million bpd, which rose to 25.22 million bpd in 2015. There were huge variations from country to country. For example, production collapsed in Syria and Yemen because of violence and instability. Iranian output slumped as United Nations (UN) sanctions were enacted. Iraqi output began to recover as the new government began to rehabilitate oil infrastructure and achieve better security along the lines of supply.

Table 4 presents Middle Eastern oil product consumption by country. Overall, demand grew at an average rate of 0.8% per year from 2009 to 2015. Demand was 7.88 million bpd in 2009 and 8.23 million bpd in 2015. Strife in Syria and Yemen, which crippled production, also caused demand to fall. Demand also fell in Iran during the time of the UN sanctions. Rapid growth in demand was seen in Oman, Qatar, Saudi Arabia, and the UAE.

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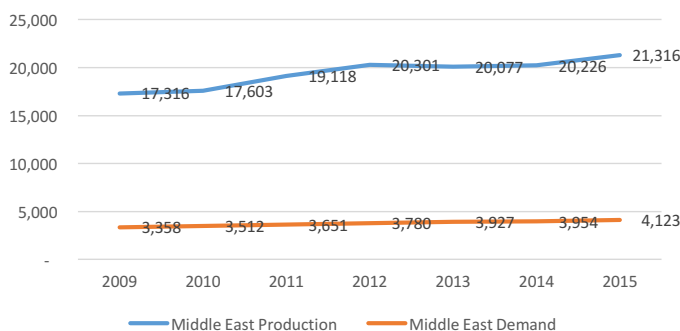


Figure 2. Middle East: growing source of crude exports.

Bahrain

Bahrain is a small country with moderate growth in demand. The country's crude oil production is well above demand. In 2009, crude production averaged 182 000 bpd, which grew to 202 000 bpd in 2015. Oil demand rose from a modest 25 000 bpd in 2009 to 29 000 bpd in 2015. The exportable surplus grew from approximately 157 000 bpd in 2009 to 173 000 bpd in 2015.

Iran

Iran is one of the original founding members of OPEC, along with Iraq, Kuwait, Saudi Arabia and Venezuela.

Iranian oil production slumped under the UN international sanctions. In 2015, the UN set out a schedule for lifting sanctions, and production began to rise. According to BP, crude and natural gas liquid (NGL) production averaged 3.62 million bpd in 2013, which rose to 4.6 million bpd in 2016. OPEC reports that Iranian production of crude oil only rose from 3.5 million bpd in 2016 to 3.81 million bpd during the first three quarters of 2017. Iran is a participant in the OPEC production cut agreement, but since the country had determined to raise its output to pre-sanctions levels, it negotiated a high production cap of 3.8 million bpd.

Iraq

Iraq's oil industry has endured numerous ups and downs relating to the Iranian Revolution, the Iran-Iraq War, and the Iraq Civil War. Exports from northern oilfields are currently in a state of flux. In September 2017, Iraqi Kurds voted overwhelmingly to declare independence from Iraq. This is strongly opposed by the Iraqi government, as well as by neighbouring governments who wish to avoid having Kurdish separatist movements in their countries. At the time of writing this article, the Kurdish government is not pressing for immediate independence in order to keep peace and the oil flowing.

Iraqi crude production rose from 2.35 million bpd in 2009 to 3.48 million bpd in 2015. According to OPEC, Iraqi production then climbed to 4.39 million bpd in 2016. Iraq is a participant in the OPEC production cut agreement, though the country initially refused to join, citing the need for oil export revenues to help fund its fight against terrorism. Eventually, the country joined the effort. During the first three quarters of 2017, Iraqi crude production

averaged 4.45 million bpd, above its agreed-upon cap of 4.35 million bpd.

The country's oil demand grew from 401 000 bpd in 2009 to 584 000 bpd in 2013, before subsiding to 464 000 bpd in 2015. This OPEC figure appears to understate demand, most likely because Iraq burns crude oil directly at electric power plants in quantities of approximately 150 000 – 200 000 bpd.

Israel

Israel has very little by way of oil reserves. The Heletz oilfield in the southern part of the country has been in commercial production since its discovery in the 1950s, and there are currently two active licenses,

Heletz Kochav and Iris. The Lapidoth company reports that over 17 million bbls have been produced over the life of the field – a small volume in the overall pattern of demand. The International Energy Agency (IEA) reported Israel's crude oil production in 2015 at 76 000 t, or approximately 1500 bpd. Crude oil use was 235 900 bpd, meaning that the country produced approximately 0.6% of its crude oil requirement.

Israel is now developing a successful natural gas industry, with commercial production from the Tamar field since 2013. A larger field, known as Leviathan, is expected to begin exports in 2019. The country has instituted numerous energy policies to reduce oil demand, and these have kept demand nearly flat for many years. BP reports that Israeli oil demand was 254 000 bpd in 1996 vs 251 000 bpd in 2016 – a slight decline. Over the last 20 years, demand has generally remained in the range of 230 000 – 290 000 bpd.

In the electric power sector, the government plans to raise electricity generated from renewable energy sources from 5.3% of the mix in 2014 – 2015 to 10.2% by the year 2020. In the transport sector, Israel has also been promoting the use of non-petroleum fuels, chiefly CNG as a diesel substitute in trucks and buses, methanol-gasoline blends for private flexible fuel vehicles, and gas-to-liquids (GTL) diesel in buses, trucks and high-mileage vehicles.

Jordan

Jordan imports essentially all of its oil, with net oil imports of 94 000 bpd in 2009 rising to 152 000 bpd in 2014. Imports declined to 131 000 bpd in 2015.

Kuwait

The first commercial oil discovery in Kuwait was at the Burgan field in 1938 and commercial exports began in 1946. Like many neighbouring countries, Kuwait's oil production dropped sharply during the oil price shocks of the 1970s. War has also impacted the energy sector, notably in 1990 – 1991, when Iraq invaded Kuwait. The Iraq-Kuwait War included a seven month long occupation of Kuwait, before the UN demanded an Iraqi withdrawal.

The country's crude production grew from 2.26 million bpd in 2009 to 2.87 million bpd in 2012 but fell to 2.69 million bpd in 2014 before rising again to 2.88 million bpd in 2015. According to OPEC, Kuwait's crude oil production averaged 2.85 million bpd in 2016, and 2.71 million bpd in the first three quarters of 2017. Kuwait is



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a participant in the OPEC production cut agreement, and its production cap was set at 2.72 million bpd as of January 2017. The country has adhered to this cap.

Lebanon

Lebanon imports all of its crude oil requirement. The country has a single, gasoline-oriented refinery. OAEPC reported its refinery output at approximately 65 000 bpd in 2015. Over half of its refined product demand was imported. Oil imports have been roughly stable with a slight upward trend, averaging 132 000 bpd in 2015.

Oman

Oman is a significant producer of relatively high-quality crudes. Production has grown from 713 000 bpd in 2009 to 885 000 bpd in 2015. Domestic demand also has been growing steadily, rising from 109 000 bpd in 2009 to 198 000 bpd in 2015.

Qatar

Qatar is the smallest country in OPEC in terms of area and population. With abundant resources and a modest level of demand, Qatar is an important exporter. Crude production has declined in recent years, however, as attention has shifted to natural gas development and exports. The country is the largest exporter of LNG in the world, with BP listing its LNG exports at 104.4 billion m³ in 2016. Qatari crude production declined from 733 000 bpd in 2009 to 649 000 bpd in 2015. The country cut its production to an average of 613 000 bpd during the first three quarters of 2017, in line with its participation in the OPEC oil production cut agreement, in which it agreed to a production ceiling of 618 000 bpd.

Qatar has been blockaded by land by Saudi Arabia since June 2017. Bahrain and the UAE also severed diplomatic relations with Qatar at that time. These neighbouring countries accused Qatar of providing support for groups associated with terrorist activities. Qatar denied this and refused to accede to any demands that interfered with its sovereignty. Initially, food and consumer goods were in short supply, but imports began to arrive from countries such as Iran and Egypt. Natural gas and most oil exports have continued.

Saudi Arabia

Saudi Arabia is the world's largest oil producer. It has used its massive production capability to serve as a regional swing producer. However, the shale boom in the US, combined with production gains from other countries, began to erode Saudi Arabia's market share to the point that the country launched the oil price war. The Saudi Arabian kingdom boosted output, causing prices to plummet, which drove some high-cost producers out of the market. Last year, Saudi Arabia played the key role in OPEC efforts to bring the global oil supply glut back under control and strengthen prices once again.

Saudi Arabian crude production rose from 8.18 million bpd in 2009 to 10.19 million bpd in 2015. OPEC reported that its crude production averaged 10.41 million bpd in 2016. The country cut production

sharply in order to reduce the supply glut, and production has averaged 9.95 million bpd during the first three quarters of 2017. The Saudi cuts have gone well below their commitment, which was set at 10.51 million bpd.

Syria

Syria has been wracked by armed conflict. The current civil war evolved as a continuation of the 2011 Arab Spring uprisings, when protestors marched on the capitol demanding democratic reforms and the release of political prisoners. Several armed factions are now vying for control of the country. There have been numerous attempts to structure a peace in Syria, including one hosted by the UN in Geneva in March 2017, but the fighting has continued.

Syrian crude production plunged from 375 000 bpd in 2009 to 10 000 bpd in 2014 – 2015. Domestic demand fell from 428 000 bpd in 2009 to 165 000 bpd in 2015.

UAE

The UAE is an important and growing producer of crude oil. It is also a significant exporter of LNG. Crude output grew from 2.24 million bpd in 2009 to 3 million bpd in 2015. The country has been a member of OPEC since 1967 and is a participant in the current oil production cut agreement, with an agreed-upon production cap of 2.87 million bpd in 2017. According to OPEC data, the UAE produced 2.98 million bpd of crude in 2016 and reduced its output to an average of 2.92 million bpd during the first three quarters of 2017.

The UAE has worked to diversify its economy away from overreliance on oil and gas export revenue, and it is now a major hub of trading and financial services.

Yemen

Yemen's energy sector has been severely impacted by internal unrest and violence. In 2014, rebel forces captured the capital and forced the President and his ministers to resign. Foreign firms have left the country causing crude production to fall from 284 000 bpd in 2009 to just 24 000 bpd in 2015. BP estimates that production dwindled to 16 000 bpd in 2016. Demand has declined more modestly, falling from 131 000 bpd in 2009 to 117 000 bpd in 2015, according to OAEPC.

Middle East oil production vs demand

The Middle East continued to expand its export capability between 2009 and 2015. According to OAEPC, Middle Eastern Arab countries' crude production rose from 17.32 million bpd in 2009 to 21.32 million bpd in 2015 – an increase of 4 million bpd. According to BP, which measures production in the entirety of the Middle East, production rose by a further 1.72 million bpd between 2015 and 2016.

Middle Eastern oil demand has also been growing steadily, which has kept some of the new supply within the region. OAEPC reports that demand in the Arab Middle East grew from 3.36 million bpd in 2009 to 4.12 million bpd in 2015, an increase of 765 000 bpd. In rough terms, therefore, the exportable surplus rose by 3.24 million bpd rather than the full 4 million bpd.

Nonetheless, the additional supplies from the Middle East were flowing into an already oversupplied market, and prices were low in 2015 – 2016. Inexpensive oil flowed into stockpiles around the globe, and draining these burgeoning inventories is a key goal of the current OPEC production cut agreement. As of the time of this writing in 4Q17, the production cuts appear to be having the desired impact, and prices are strengthening.

Conclusion


The MENA region is prominent in the global oil and gas industry. Eight OPEC members are in this region, producing over 80% of OPEC oil. Yet the region is also home to countries with little or no oil production that import crude, refined product or both. The imports are often sourced from their more oil-rich neighbours.

Even with these net-importing countries, MENA's exportable surplus of oil has grown significantly in recent years. However, the trend has varied enormously from country to country. The North African oil balance has grown much tighter in recent years and the exportable surplus has shrunk. Production has stagnated or declined in Algeria, Egypt and Tunisia, and it has see-sawed wildly in Libya with ongoing cycles of violence.

In contrast, Middle Eastern crude production has grown in Saudi Arabia, Iraq, Iran, the UAE, Kuwait, Oman, and Bahrain. In Qatar, oil production has declined as the focus has shifted to natural gas development. Meanwhile, production has collapsed in Syria and Yemen

because of chronic internal violence. On the whole, between 2009 and 2015, the Arab countries of the Middle East increased their crude production by approximately 4 million bpd.

In an interesting coincidence, the US also increased its crude production by over 4 million bpd during the same period. MENA and the US may be viewed as the two main contributors to the oil supply overhang, which only now is beginning to ease.

As global oil supply and demand move more closely into balance, prices have strengthened. At the time of writing, futures prices for WTI crude have surpassed US\$54/bbl, and they have remained in the US\$54 – US\$55/bbl range, the highest prices of 2017. OPEC's production cut agreement, led by Saudi Arabia, has taken some crude off the export market, and the agreement has been extended into 2018. OPEC met at the end of November, and the membership approved an extension of the production cut agreement through calendar year 2018. Moreover, within the MENA region, several countries are significant importers of oil from their neighbours, and demand is growing. Production cuts, combined with growth in MENA's demand, should take a significant volume of oil off the export market. This will tighten the supply-demand balance and help support prices. Essentially all of the producers believe they could use additional oil export revenue but it remains to be seen how much additional supply will be tempted into the market if prices reach US\$60/bbl in 2018. 



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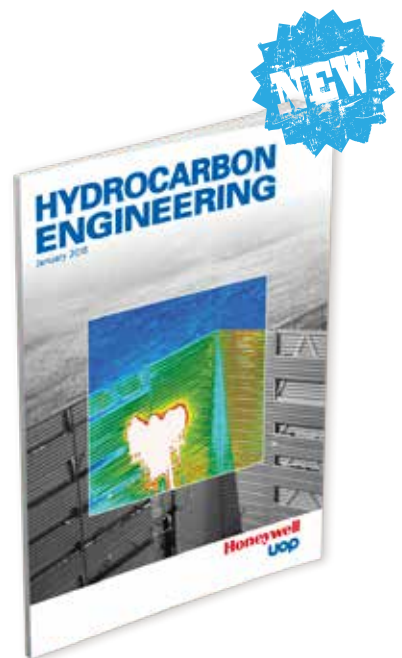
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